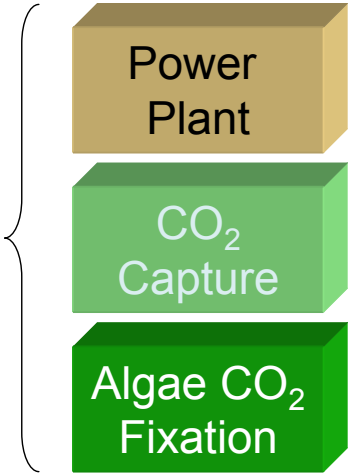
Carbon Capture Corporation

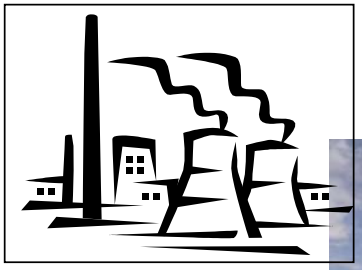
Economic and Technology Advancement Advisory Committee

September 6, 2007

The Concept

- **Carbon Capture Corporation**
  - **Integrate**
    - **Peak Power Production Plant**
    - **Carbon Capture Technology**
    - **Algae-Based Carbon Dioxide (CO_2) Absorption**
  - **Deliver**
    - **CO_2 Emission Free Energy**
    - **Scalable CO_2 Mitigation Solution through Photosynthetic CO_2 Absorption in Algae**
    - **Algae as a By-Product**
      - **Biological Food Source**
      - **Biofuel**





Power Plant Emissions

CO_2 Emissions Scrubber

Algae Farm

The Company

- **Privately Held, Based in La Jolla & Imperial Valley, California**
- **Management, R&D Staff & Consultants Include:**
  - ✓ **Paul Engh,** CEO
  - ✓ **Craig Metz,** EVP
  - ✓ **Bernard Raemy,** Energy Development
  - ✓ **Ed Hale,** Government Relations
  - ✓ **Martin Gordon,** Process Development
  - ✓ **Jim DeMattia,** Aquatic Biology
  - ✓ **Bill Engler,** CEO and Founder, Aquafarms, Advisory Board
  - ✓ **Andrew Benedek,** Founder, ZENON Environmental, Advisory Board
  - ✓ **Tom Daniel, M.D., President,** Research at Celgene, Advisory Board
  - ✓ **Don Engh,** Mechanical Engineering
  - ✓ **Stuart Bussell, Ph.D.,** Process Development Advisor
  - ✓ **Dallas Weaver, Ph.D.,** Consultant
  - ✓ **Alina Tan,** Consultant
  - ✓ **Leo Sullivan,** Legal Affairs

One 40-Acre Site (Calipatria, CA), Over 800 Acres Acquired To Date in Imperial valley, CA

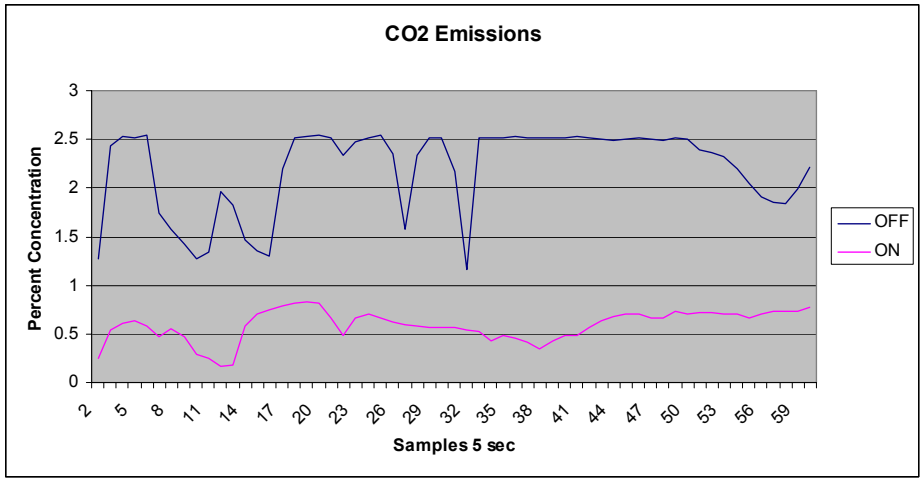
Testing Program

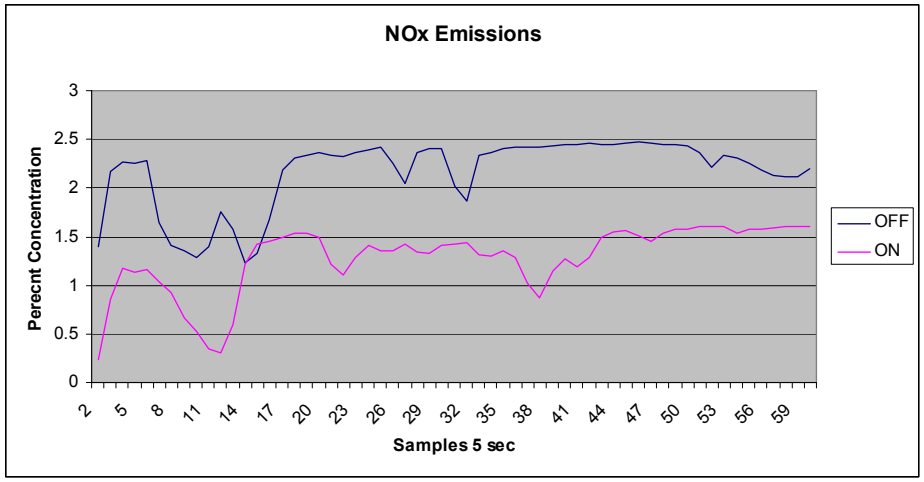
Test Program	Equipment	Status
Phase 1	**Diesel Generator (5 hp)**	**Complete (Proof of Concept)**
Phase 2	**➢ Two 30 kW LPG Capstone 330** **➢ One Diesel Engine (80 hp)**	**➢ Preliminary Test Results** **➢ Testing in Progress** **➢ Test Results Late 2007**
Phase 3	**➢ One 1 MW Gas Turbine (Natural Gas)** **➢ One 2.5 MW Engine (Bio Diesel)**	**➢ In Design / Fabrication** **➢Test Results Mid 2008**
Phase 4	**46 MW Gas Turbine (Natural Gas)**	**➢ Permits Secured** **➢ Interconnection Expected Spring 2008** **➢ Commercial Operation Targeted Spring 2009**

Air Quality Monitoring
Test # 2: June 2, 2007

- 5 HP Diesel Engine (idle)
- Using 6 of 7 Chambers within Column
  - CO_2: 72% Reduction
  - NO_x: 41% Reduction
  - CO : 15% Reduction

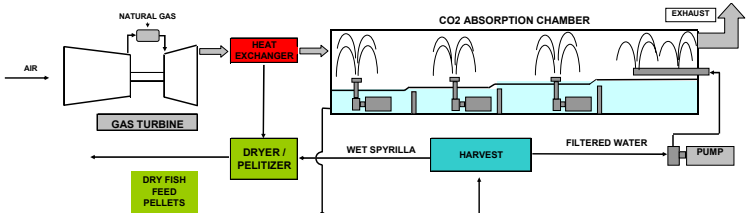
Testo 350-S Control - XL Analyzer





Air Quality Monitoring
Test # 3: Preliminary Indications

Air Velocity [ft/min]	CO_2 in [%]	CO_2 Capture [%]
900	1.51	11
300	1.51	29
200	1.51	41
200	4.56*	40



*** Pure CO2 Added**

Pond/Algae Production

- **What limits algae growth rates**
  - Light levels -- self shading increases with increasing density
  - CO_2 -- Available CO_2 in the growth medium
    - Available CO_2 is a function of pH and alkalinity
    - At pH > 10.5 and alkalinity of 200 meq/l the partial pressure = 4 ppmv; at pH 11 pp = 0.4 ppm
  - Nutrients
    - Fixed N as NH_3, NO_2^-, NO_3^- ; some species can fix N_2
      - Spirulina can't fix nitrogen, must be supplied
    - Soluble P -- as PO_4^{---}
    - Potassium
    - Trace elements : Fe, Zn, $B(OH)_3$, Co, Mn, Se, other?
- **Observed growth rate limits**
  - With high sun light, reasonable densities (light at the bottom) and unlimited nutrients
    - CO_2 becomes rate limiting as the free CO_2 (dissolved in the medium) or partial pressure gets down to the few ppmv range
    - A common situation in high rate algae pond waste treatment systems, even when they have significant CO_2 being added from BOD metabolism.
    - The daily pH and partial pressure variation depends upon the alkalinity -- Alkalinity up, variation down

Carbonate/CO_2 System

- $CO_2(g) \rightleftharpoons CO_2(l) + H_2O \rightleftharpoons H_2CO_3$
  - Hydration is slow step in process -- carbonic anhydrase
  - Reason for large liquid inventory in CO_2 Scrubber -- need reaction time
  - Solubility as per Henrys law -- not huge
    - $CO_2(l)$ =~ 0.029 * $CO_2(g)$ (partial pressure in atm)

- $H_2CO_3 \rightleftharpoons H^+ + HCO_3^- \rightleftharpoons 2H^+ + CO_3^{--}$
  - These reactions are all very fast
  - Equilibrium constants
    - PK_1= ~ 5.9
    - pK_2= ~ 9.2
- $H_2O \rightleftharpoons H^+ + OH^-$
- pH = - log[H+]

46 MW – Peaker Project Development Update

- **Real Estate Completed**
  - Acquired 160 Acres in March of 2007
- **Permitting Completed**
  - Conditional Use Permit from Imperial County Planning Department
  - Authority To Construct from Imperial Valley Air Pollution Control District
- **Interconnection**
  - Queue Position Secured with Imperial Irrigation District in March of 2007
  - System Impact and Facility Studies in Progress
- **Equipment Supply**
  - Contract Negotiations with Equipment and Services Suppliers
- **Marketing**
  - Preliminary Discussions with Various Off-Takers
  - Possibility to Build and Operate Merchant During the first Two Years